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diverging features, which, as they are well known, need not be repeated here. The whole course of development shows that the insects have been derived from a form like Peripatus, while the Crustacea have had an ancestor resembling the Nauplius of the Phyllopoda or the Copepoda. In both the insects and the Crustacea we have in the larval and in the adult state a serially segmented body with appendages on the metameres, but this merely points to a common Annelidan ancestor, and with the exception of the Mollusca is a feature common to almost all animals above the Cœlenterata. The ecdysis which occurs in the Arthropoda is not to be regarded as indicating close relationship, but rather as an adaptive feature, resulting from the unyielding character of the hardened integument. In short, the only point not to be easily explained, if we regard the two groups as not nearly related, is the compound eye common to both, and which occurs nowhere else in the animal kingdom. Still we have only to consider the close resemblance of the eyes of the vertebrates and of the dibranchiate Cephalopoda to see how little weight one organ can have in classification.

In the foregoing discussion, which is merely suggestive and by no means exhaustive, no attention has been paid to the Tardigrada, Pycnogonids, Limulus and Linguatulina. It may be that they will have to be elevated to groups each equivalent to the insects and Crustacea, or, as has been argued, that they are branches from the Arachnida. We do not at present know enough concerning the embryology of these groups to settle these points, but the little which we do know, when considered in connection with our anatomical data, is sufficient to show that none of them belong to the Crustacean Phylum.

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THE SERPENTINE OF STATEN ISLAND, NEW YORK.[1]

BY T. STERRY HUNT, LL.D., F.R.S.

THE serpentine of Staten island appears as a north and south range of bold hills rising out of a plain of Mesozoic rocks. On the west side are Triassic sandstones like those of the adjacent mainland, including a belt of intrusive diabase, and on the east the overlying and nearly horizontal Cretaceous marls, which are traced south and west into New Jersey. The only rocks be-

[1] Read at Minneapolis meeting of A. A. A. S., Aug. 21, 1883.

sides those here mentioned seen on the island, are small areas of coarse-grained granite, having the characters of a veinstone or endogenous mass, and others of an actinolite rock, both exposed among the sands on the north-east shore of the island.

Mather, who described this locality forty years since, looked upon the serpentine as an eruptive rock like the parallel belt of diabase seen to the west of it, but Dr. N. L. Britton, of the New York School of Mines, who in 1880 published in the Proceedings of the New York Academy of Sciences a description and geological map of the island, recognized the serpentine as similar to that which is stratified as a contemporaneous member in the ancient gneissic series of Manhatten island, and appears also at Hoboken, a view which is doubtless correct.

The appearance of isolated hills of serpentine rising among newer rocks is common in other regions, and is by the writer attributed to the fact that this insoluble magnesian silicate resists to a great degree the action of subaërial decay, which converts gneisses and other feldspathic rocks into a clay that is easily removed, leaving the beds and other lenticular masses of interbedded serpentine in relief. In many parts of Italy, where ridges or belts of serpentine protrude in the midst of Tertiary strata, they have been described by the earlier observers as eruptive masses. The question of their geognostical relations is there often complicated by the fact that subsequent movements of the earth's crust have involved alike the underlying serpentines and the newer strata, and have given rise to faults and inversions by which the younger rocks, overturned, are made to dip towards and even beneath the older. This condition of things the writer illustrated by reference to localities of serpentine lately scanned by him in Liguria and in Tuscany, where the true geognostical relations of these rocks had been first indicated by Gastaldi. The structure above described was farther explained by reference to the similar inversions of strata along the western base of the Atlantic belt from the Highlands of the Hudson southward along the Appalachian valley.

The writer stated that although serpentine, under subaërial influences, decays much less rapidly than the harder gneisses, it does not entirely escape this process. He showed that this rock on Staten island is covered in parts with a decayed layer, including portions of limonite separated by a process of segregation in preglacial times, since in the subsequent erosion it has been removed from many parts of the serpentine belt. The details of this decomposition of the serpentine and of its relation to glacial erosion have been discussed by the writer in an essay on rock decay, to appear in the *American Journal of Science* for September, 1883. He acknowledged in conclusion his obligations to Dr. Britton for his careful description and for his personal guidance on Staten island.

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A CLASSIFICATION OF THE NATURAL SCIENCES.[1]

BY T. STERRY HUNT, LL.D, F.R.S.

TO frame a rational classification of the natural sciences, and to define their mutual relations, has often been attempted. The present writer, in an essay read before the National Academy of Sciences in 1881, and published in the *L. E. & D. Philosophical Magazine* under the title of "The Domain of Physiology," suggested the basis of such a scheme, and now, at the suggestion of some of his readers, ventures to embody in a concise and tabulated form the views then and there enunciated, in the hope that other students may find it not unworthy of their notice.

The study of material nature, or of the physical universe (for the terms natural and physical are synonymous), constitutes what the older scholars correctly and comprehensively termed physics, and presents itself in a two-fold aspect; first, as descriptive, and second, as philosophical; a distinction embodied in the terms natural history and natural philosophy, or more concisely in the words physiography and physiology. The latter word has, from the time of Aristotle, been employed in this general sense to designate the philosophical study of nature, and will be so used in the present classification.

The world of nature is divided into the inorganic or mineralogical and the organic or biological kingdoms, the divisions of the latter into vegetable and animal being a subordinate one. The natural history or physiography of the inorganic kingdom takes cognizance of the sensible characters of mineral species, and gives us descriptive and systematic mineralogy, which have hitherto been restricted to native species, but in a wider sense include

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[1] Read in general session at Minneapolis meeting of A. A. A. S., Aug., 1883.